User's Manual

E1/E20 Emulator

Additional Document for User's Manual (Note on Connection for RL78)

Supported Devices:
RL78 Family
RL78/D1A, RL78/F12, RL78/F13, RL78/F14,RL78/F1A,
RL78/G12, RL78/G13, RL78/G14, RL78/G1A,
RL78/G1C, RL78/G1E,
RL78/I1A, RL78/I1B, RL78/I1D,
RL78/L12, RL78/L13, RL78/L1C

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Terminology

Some specific words used in this user's manual are defined below.

Host machine
This means a personal computer used to control the emulator.

User system
This means a user's application system in which the MCU to be debugged is used.

User program
This means the program to be debugged.

Programming Software
In this document, this indicates Renesas Flash Programmer that can be used with the E1 or E20.

"#" at the end of a pin name (signal name)
"#" at the end of a pin name (signal name) indicates that the pin (signal) is active low (e.g., RESET#).

1. Overview

1.1. Overview of E1 and E20 Emulators

The E1 and E20 are on-chip debugging emulators for Renesas's mainstream MCUs.
The E1 emulator is a highly affordable development tool providing basic debugging functions. The E20 emulator is a development tool allowing sophisticated debugging through enhanced functions such as tracing and RAM monitoring as well as the basic debugging functions of the E1. The E1 and E20 emulators can also serve as a Flash Programmer.

1.2. Note on Using E20 Emulator

To use the large trace function and the realtime RAM monitoring function, which are the primary features of the E20 emulator, the target MCU must be equipped with a pin for outputting trace information.

The available functions are equivalent to those of the E1 emulator (only the internal trace function in the MCU and memory reference and modification during execution).
The power supply function from the E20 is not supported.

1.3. Configuration of E1/E20 Emulator Manuals

The E1/E20 manual consists of multiple parts: the E1/E20 Emulator User's Manual and the additional documents for the user's manual for each MCU.
Be sure to read each part before using the E1/E20 emulator.

(1) E1/E20 emulator user’s manual

The E1/E20 emulator user’s manual has the following contents:

- Components of the emulators
- Emulator hardware specification
- Connection to the emulator and the host machine and user system

(2) E1/E20 Additional Documents for User's Manual (Note on connectiong fo RL78)

The E1/E20 Additional Documents for User's Manual (Note on connectiong fo RL78) describes information necessary for hardware design such as connection examples , interface circuits, and notes on using the emulator.

(3) User’s manual and help for the emulator debugger

The user’s manual and help for the emulator debugger describe the functions of the E1/E20 emulator debugger and the operating instructions.

- CubeSuite+ Integrated Development Environment User's Manual: RL78 Debug
- Help for e2 studio
- RL78 Family CubeSuite+ Debugging Using Hot Plug-in Function

When using C-SPY made by IAR Systems, also refer to "IAR C-SPY Hardware Debugger System User Guide issued by IAR Systems" published by IAR Systems.

1.4. Supported Devices

Table 1-1 Supported Device List

Item	Description
Target MCUs	RL78 Family(RL78-S2 Core) *1
	RL78/D1x : RL78/D1A
	RL78/F1x : RL78/F12
	RL78/G1x : RL78/G12,RL78/G13,RL78/G1A,RL78/G1C,RL78/G1E
	RL78/I1x : RL78/I1A
	RL78/L1x : RL78/L12,RL78/L13
	RL78 Family(RL78-S3 Core) *1
	RL78/F1x : RL78/F13,RL78/F14,RL78/F1A
	RL78/G1x : RL78/G14
	RL78/I1x : RL78/I1B,RL78/ID
	RL78/L1x : RL78/L1C

*1 For details on the RL78-S2 core or RL78-S3 core, refer to "RL78 Family User's Manual: Software".

Table 1-2 Debugging Function List

Item		Type of the RL78 Core		Description
		RL78-S2	RL78-S3	
Memory reference or change during program execution				
Pseudo real-time RAM monitor(RRM)		Supported	Supported	CPU is used when monitoring
Dynamic Memory Modification(DMM)		Supported	Supported	CPU is used when changing
Event		1 points	2 points (max)	Can be used for hardware break (or trace*1)
Break	Software break	Supported	Supported	2000 points
	Hardware break	Supported	Supported	Commonly used by execution and access
	Forced break	Supported	Supported	
Trace	Acquired information	Not supported	Supported *2	Branch source PC information
	Start event	Not supported	Supported *2	User program execution start and event start
	End event	Not supported	Supported *2	User program stop, event completion, and full trace memory
Performance measurement function	Measurement item	Supported	Supported	Between start and stop of user program execution
	Performance	Supported	Supported	Resolution 100 µs(max) measurement time 119 hours 18 min
Hot plug-in		Not supported	Supported *3	
Coverage measurement function		Not supported	Not supported	

Notes: 1 Only devices in which the trace function was implemented.
2 The trace function is not supported in an RL78/G14 MCU whose ROM size is 64 Kbytes or less.
3 Only RL78/F13 and RL78/F14 ,RL78/F1A.

2. Designing the User System

2.1. Connecting the E1/E20 Emulator with the User System

To connect the E1 or E20 emulator (hereinafter referred to as the emulator), a connector for the user system interface cable must be mounted on the user system.
When designing the user system, read this section of this manual and the hardware manual for the MCUs.

2.2. Installing the Connector on the User System

Table 2-1 shows the recommended connectors for the E1 and E20 emulators.

Table 2-1 Recommended Connectors

Connector	Type Number	Manufacturer	Specifications
14-pin connector	7614-6002	Sumitomo 3M Limited	14-pin straight type (Japan)
	2514-6002	3M Limited	14-pin straight type (other countries)

*1 38-pin of the E20 is not supported. To use the E20, use the 38-pin/14-pin conversion adapter [R0E000200CKA00] that comes with the E20 for connection.

2.2.1. Connecting the User System Interface Cable to the 14-Pin Connector

Figure 2-1 show an example of the connection between a user system interface cable of the 14-pin type and an E1.
Figure 2-2 show an example of connection of the cable with the 14-pin connector to the E20 via the 38-pin to 14-pin conversion adapter.

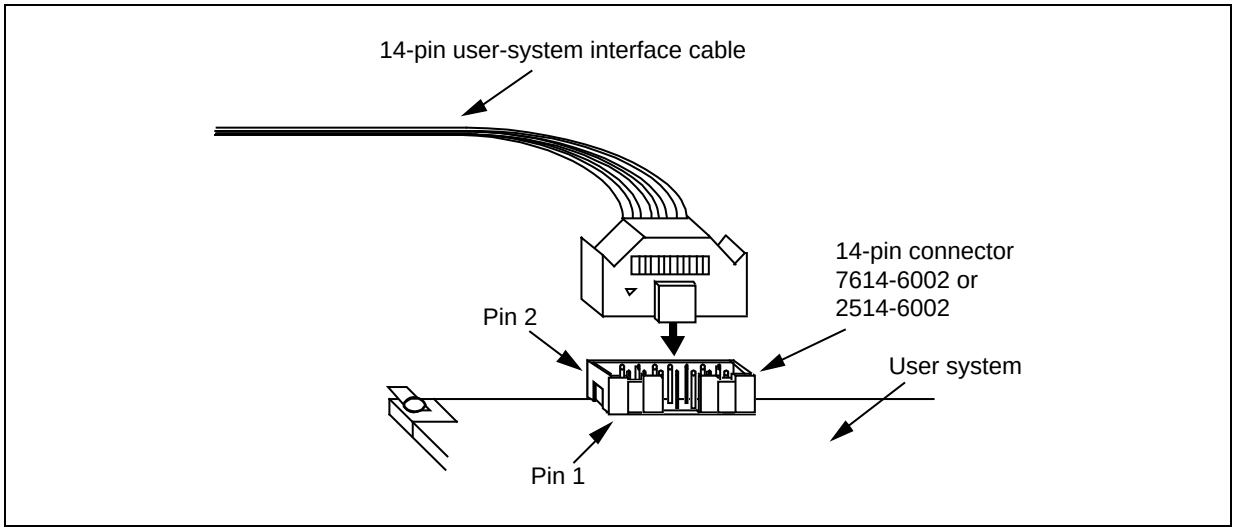


Figure 2-1 Connecting the User System Interface Cable to the 14-Pin Connector of the E1 Emulator

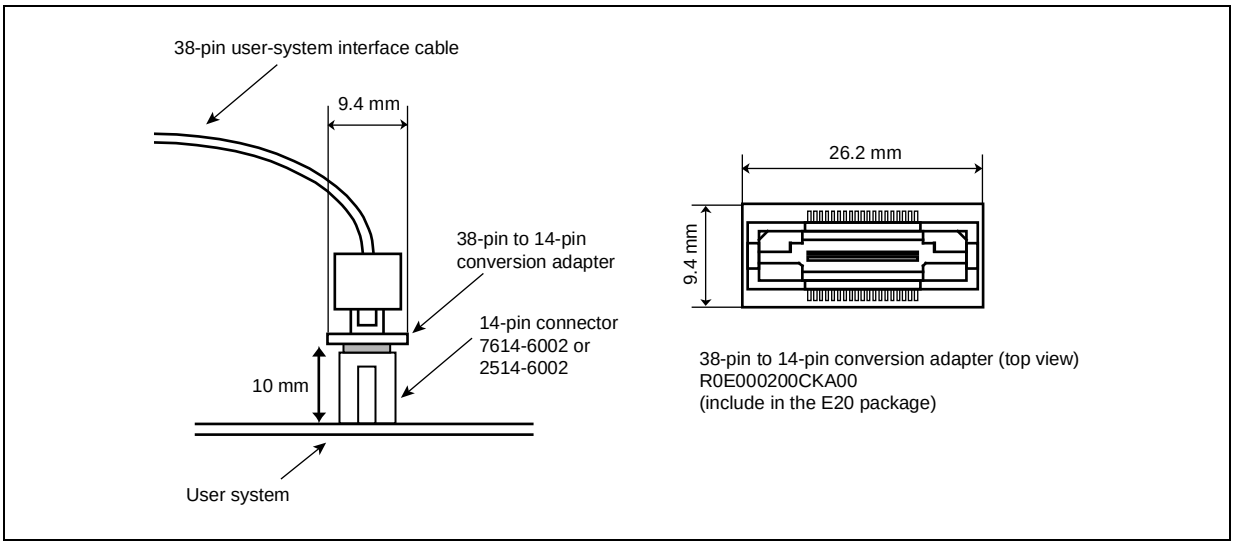
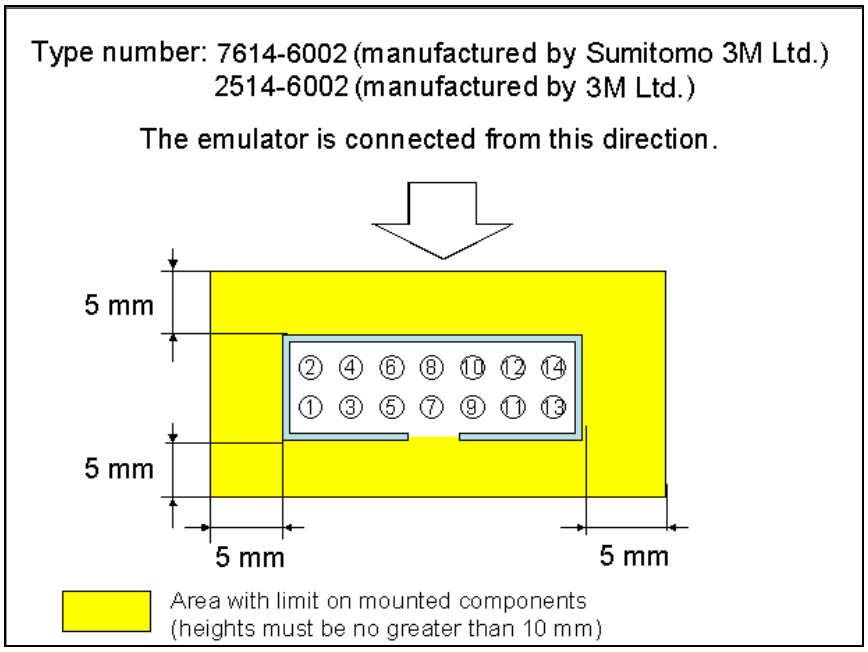


Figure 2-2 Connecting the User System Interface Cable to the 14-Pin Connector of the E20 Emulator

CAUTION

Limit to the height on connector periphery:

For a case where the R0E000200CKA00 is used for connecting the E20 emulator to a 14-pin connector, do not mount other components with a height of 10 mm or more within 5 mm of the connector on the user system.

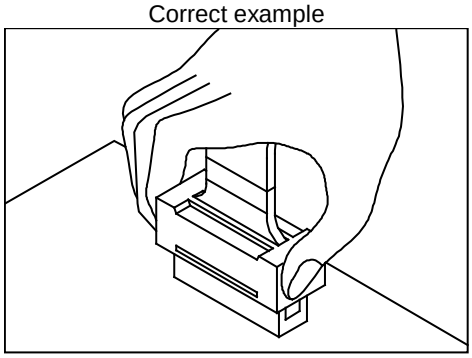

Type number: 7614-6002 (manufactured by Sumitomo 3M Ltd.)
2514-6002 (manufactured by 3M Ltd.)
The emulator is connected from this direction.
5 mm
5 mm
5 mm
5 mm
② ④ ⑥ ⑧ ⑩ ⑫ ⑭
① ③ ⑤ ⑦ ⑨ ⑪ ⑬
Area with limit on mounted components
(heights must be no greater than 10 mm)

CAUTION

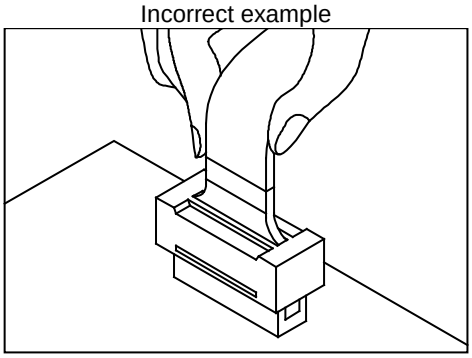
Notes on connector insertion and removal:

When connecting or disconnecting the user-system interface cable and the emulator or user system, grasp the connector cover at the end of the cable. Pulling the cable itself will damage the wiring.
Also, be aware that the user-system interface cable has the direction in which it must be inserted. If the cable is connected in the wrong direction, it may be damaged.

Correct example



Incorrect example



2.3. Pin Assignments of the Connector on the User System

2.3.1. 14-Pin Connector Specifications

Figure 2-3 shows the specifications of the 14-pin connector.
Table 2-2 on the following pages shows the pin assignments.

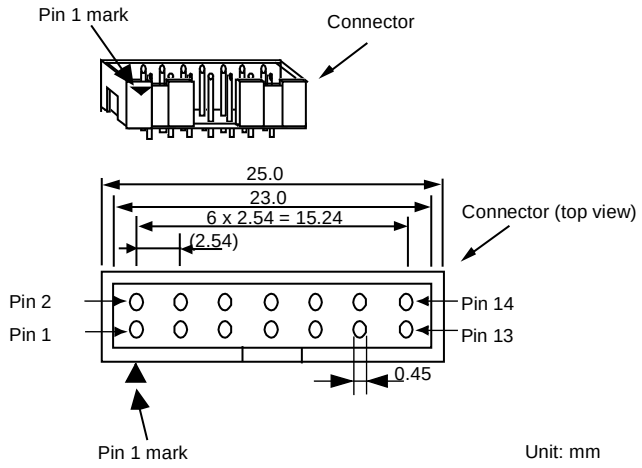


Figure 2-3 Emulator Connector Specifications (14 Pin)

Table 2-2 14-Pin Connector Pin Assignments

Pin No	Other than the 20-pin and 24-pin versions of RL78/G12		20-pin and 24-pin versions of RL78/G12		Note
	Signal *1 *2	Direction *3	Signal *1 *2	Direction *3	
1	R.F.U *6	—	R.F.U *6	—	
2	GND *4	—	GND *4	—	
3	R.F.U *6	—	R.F.U *6	—	
4	R.F.U *6	—	RSTPU	Input	This pin is used to pull up the reset line. (Only when selecting the 20-pin or 24-pin version of the RL78/G12.)
5	TOOL0	I/O	TOOL0	I/O	This pin is used to transmit command/data to the target device
6	RESET_IN	Output	RESET_IN	Output	This pin is used to input reset signal from the user system
7	R.F.U *6	—	R.F.U *6	—	
8	VDD	—	VDD	—	
9	EMVDD *7	—	EMVDD *7	—	
10	RESET_OUT *5	Input	RESET_OUT *5	Input	This pin is used to output reset signal to the target device
11	R.F.U *6	—	R.F.U *6	—	
12	GND *4	—	GND *4	—	
13	RESET_OUT *5	Input	RESET_OUT *5	Input	This pin is used to output reset signal to the target device
14	GND *4	—	GND *4	—	

*1 For details on the programming software, refer to
http://www.renesas.com/products/tools/flash_prom_programming/

*2 These are the names of the MCU pins at the time the E1 or E20 is connected (i.e. during debugging).

*3 Input to or output from the user system.

*4 Securely connect pins 2, 12, and 14 of the connector to GND of the user system. These pins are used for electrical grounding as well as for monitoring of connection with the user system by the E1/E20.

*5 Securely connect both pin 10 and pin 13.

*6 This pin is reserved. For the connection of the reserved pins, see each circuit related to the pins.

*7 Connect the drive power of the TOOL0 pin.
Please connect VDD when the MCU doesn't have power supplies other than VDD such as EVDD.

2.4. Recommended Circuit between the Connector and the MCU

This section shows recommended circuits for connection between the connector and the MCU when the E1 or E20 emulator is in use. For processing of signals, refer to section 2.5, Notes on Connection.

2.4.1. Connection between the 14-Pin Connector and the RL78 family MCUs (Except 20-Pin and 24-Pin Versions of the RL78/G12).

Figure 2-4 shows a recommended circuit for connection between the 14-pin connector and the RL78 family MCUs (except the 20-pin and 24-pin version of the RL78/G12). Note that though the format of the figure has been changed from the old edition (R20UT1994EJ0200) of this manual, the contents of the recommended circuit have not been changed.

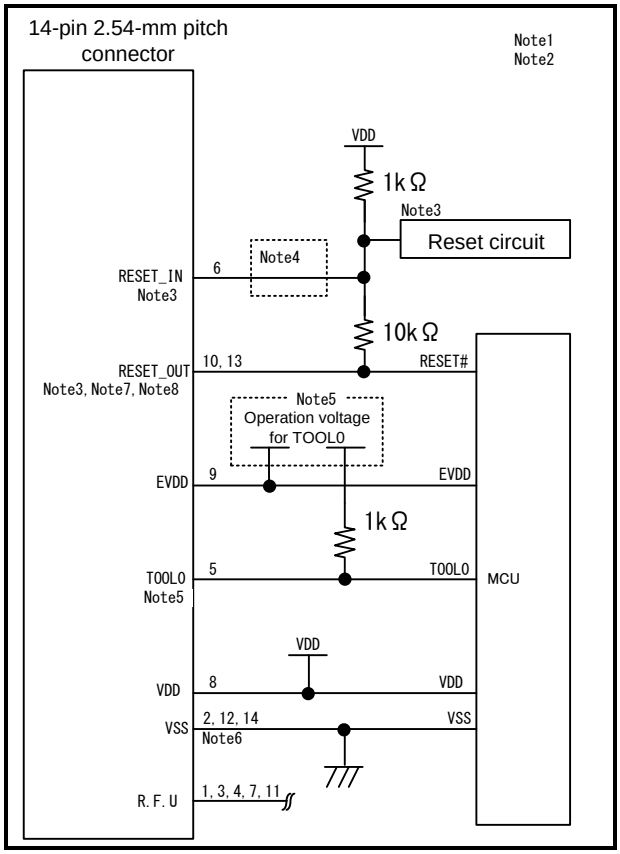


Figure 2-4 Example of Connecting Between the 14-Pin Connector and the RL78 Family MCUs (Except the 20-Pin and 24-Pin Version of RL78/G12).

Notes:
1. The circuits and resistance values listed are recommended but not guaranteed. Determine the circuit design and resistance values by taking into account the specifications of the target device and noise. For flash programming for mass production, perform sufficient evaluation about whether the specifications of the target device are satisfied.
2. For processing of pins not used by the E1/E20, refer to the user's manual of the device.
3. For details on how to handle the RESET# pin, refer to section 2.5 Notes on Connection
4. The RESET_IN pin is used only in debugging. It is not necessary in flash programming by the programming software.
5. The drive power supply of TOOL0 is different depending on devices. Defer to user's manual of device. Please connect VDD when the MCU doesn't have power supplies other than VDD such as EVDD.
6. Securely connect pins 2, 12, and 14 of the connection to GND of the user system. These pins are used for electrical grounding as well as for monitoring of connection with the user system by the E1/E20.
7. Securely connect both pin 10 and pin 13.
8. When you use hot plug-in, install a ceramic capacitor (approx. 0.1 µF) between the RESET# pin and GND in order to suppress a noise to the RESET# pin that would occur when the emulator is connected.

2.4.2. Connection between the 14-Pin Connector and the RL78 Family MCUs (Only the 20-Pin and 24-Pin Version of the RL78/G12).

Figure 2-5 shows a recommended circuit for connection between the 14-pin connector and the RL78 family MCUs (only the 20-pin and 24-pin version of the RL78/G12). Note that though the format of the figure has been changed from the old edition (R20UT1994EJ0200) of this manual, the contents of the recommended circuit have not been changed.

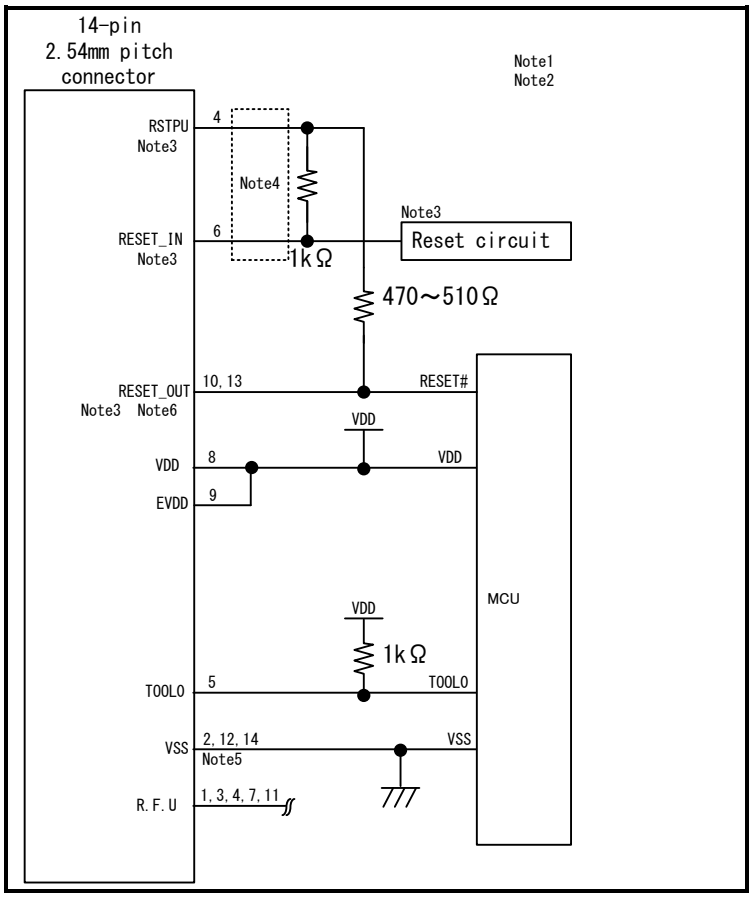


Figure 2-5 Example of Connection between the 14-Pin Connector and the RL78 family MCUs (Only the 20-Pin and 24-Pin Version of the RL78/G12).

Notes:
1. The circuits and resistance values listed are recommended but not guaranteed. Determine the circuit design and resistance values by taking into account the specifications of the target device and noise. For flash programming for mass production, perform sufficient evaluation about whether the specifications of the target device are satisfied.
2. For processing of pins not used by the E1/E20, refer to the user's manual of the device.
3. For details on how to handle the RESET# pin, refer to section 2.5 Notes on Connection.
4. The RESET_IN pin is used only in debugging. It is not necessary in flash programming by the programming software.
5. Securely connect pins 2, 12, and 14 of the connection to GND of the user system. These pins are used for electrical grounding as well as for monitoring of connection with the user system by the E1/E20.
6. Securely connect both pin 10 and pin 13.

2.5. Notes on Connection

Wiring patterns between the connector and the MCU must be as short as possible (within 50 mm is recommended). Do not connect the signal lines between the connector and MCU to other signal lines.
For the handling of pins while the E1 or E20 emulator is not in use, refer to the hardware manual for the MCU.

2.5.1. RESET# Pin

The RESET# pin is used by the E1 or E20 emulator to monitor the pin state and issue a reset to the device.
Therefore, a reset signal on the user system is once input to the E1 or E20 emulator where it is controlled by masking and then output to the target device. Connection examples of the RESET# pin section are shown in
Table 2-3 and Figure 2-6 to Figure 2-10.
When flash programming by the programming software is to be performed, the RESET# pin should be designed so that the reset signal on the user system does not conflict with the reset signal from the E1 or E20 emulator.

When you use hot plug-in, install a ceramic capacitor (approx. 0.1 µF) between the RESET# pin and GND in order to suppress a noise to the RESET# pin that would occur when the emulator is connected.
Hot plug-ins are not available if there is no reset circuit.

Table 2-3 Connection Examples According to the Reset Circuit on the User System

No	Target Device	Case	Reference
1	20-pin and 24-pin versions of the RL78/G12	There is a reset circuit on the user system.	Figure 2-6
2		There is no reset circuit on the user system. (when using the P125/KR1/SI01 function which is multiplexed with RESET#)	Figure 2-7
3	Other than above	There is a reset circuit on the user system. (Resistors are used to switch between usage and non-usage of the emulator)	Figure 2-8
4		There is a reset circuit on the user system. (A jumper is used to switch between usage and non-usage of the emulator)	Figure 2-9
5		The power-on reset circuit is the only reset circuit on the user system.	Figure 2-10

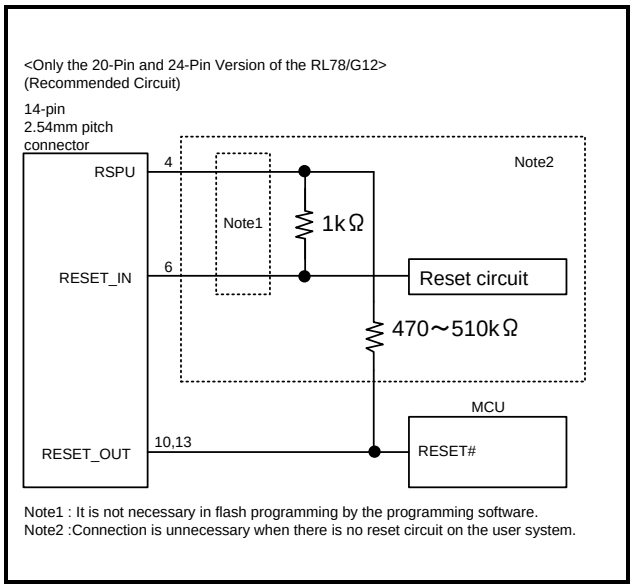


Figure 2-6 Connection of RESET#
(Only the 20-Pin and 24-Pin Version of the RL78/G12)

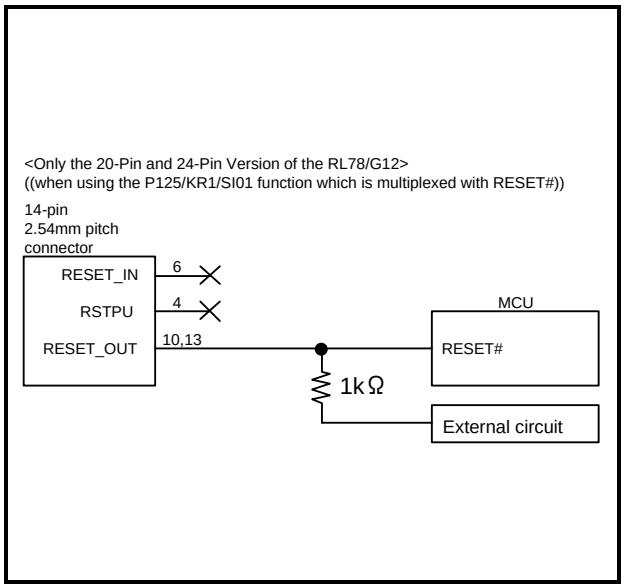


Figure 2-7 Connection of RESET#
(Only the 20-Pin and 24-Pin Version of the RL78/G12)

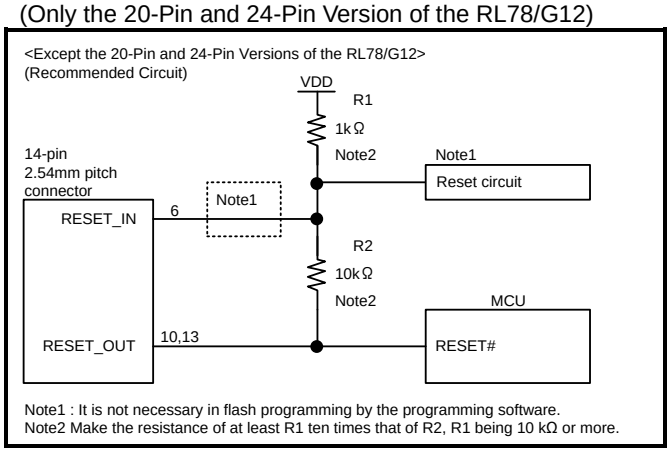


Figure 2-8 Connection of RESET#
(Except the 20-Pin and 24-Pin Versions of the RL78/G12)

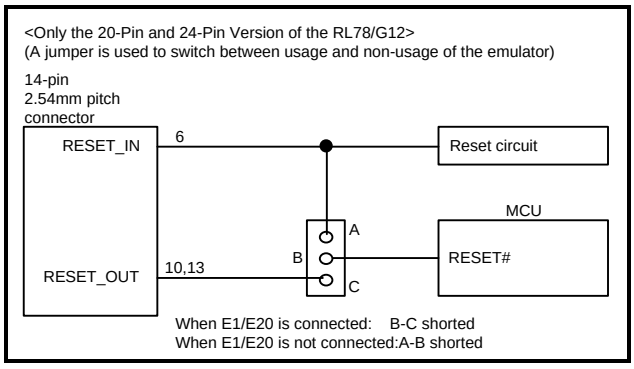


Figure 2-9 Connection of RESET#
(Except the 20-Pin and 24-Pin Versions of the RL78/G12)

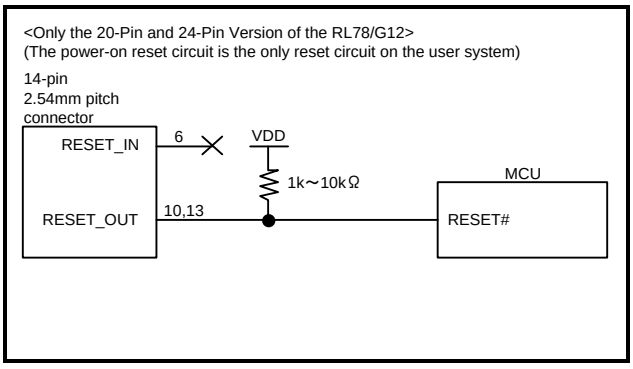


Figure 2-10 Connection of RESET#
(Except the 20-Pin and 24-Pin Versions of the RL78/G12)

- Do not install capacitors, series resistors, or filters on signal lines; if attempted, correct communication may not be established.
- The circuits and resistance values listed are recommended but not guaranteed. Determine the circuit design and resistance values by taking into account the specifications of the target device and noise.
- Securely connect pins 2, 12, and 14 to GND of the user system. These pins are used for electrical grounding as well as for monitoring of connection with the user system by the E1/E20.
- Securely connect both pin 10 and pin 13.

2.5.2. TOOL0 Pin

The emulator uses the TOOL0 pins. Any functions that are multiplexed on these pins are not available. Pull up the signals of TOOL0 pin at 1kΩ and do not arrange these signal lines in parallel with or across other high-speed signal lines.

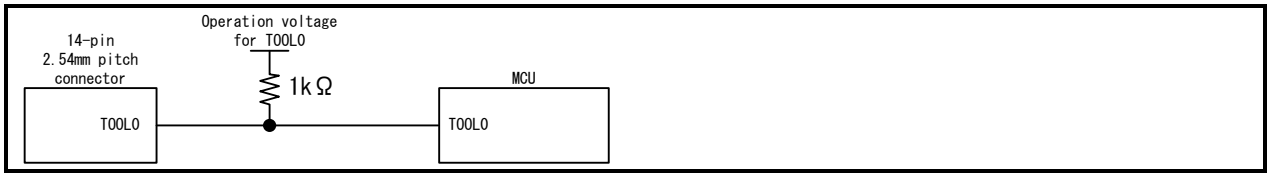


Figure 2-11 Connection of the TOOL0 Pin

Do not use adjacent resistors for pull-up of the TCK pin because they may affect or may be affected from other pins.
Do not install capacitors, series resistors, or filters on signal lines; if attempted, correct communication may not be established.

2.5.3. GND

The pins of the connector marked "GND" must be at the same ground level as the VSS pin of the MCU.

2.5.4. VDD

Connect the VDD of the connector to the VDD (power supply) of the user system.
Use the emulator within the power supply voltage of 1.8V to 5.5V and within the operating voltage range of the MCU.
When power is supplied to the user system from other than the emulator, E1/E20 emulator consumes the power supply for the last output and first input buffers of the emulator.

E1 emulator	: 3.3V	approximately 20mA	,	5.0V	approximately 40mA
E20 emulator	: 3.3V	approximately 40mA	,	5.0V	approximately 100mA

The E1 emulator can supply power to a simple evaluation system. Up to 200 mA current can be supplied. When using the power supply function of the E1 emulator, check the voltage supplied to the user system. Particularly, when the 5.0V supply option is selected, the voltage may drop 0.5V or more since it depends on the USB VBUS power supply voltage.

On-chip debugging circuit in the device operates during on-chip debugging.
Therefore current consumption of the device increases.
When evaluating current consumption of device, please do not connect a debugger.

Power supply from the E1 emulator depends on the quality of the USB power supply of the host machine, and as such, precision is not guaranteed. When writing a program that requires reliability, do not use the power supply function of the E1 emulator. Use a stable, separate power supply for the user system. When writing a program for mass production processes, use the Renesas Flash Programmer.
For details on the programming software, refer to
http://www.renesas.com/products/tools/flash_prom_programming/ .

WARNING

Warning for Turning the Power On/Off:

When supplying power, ensure that there are no shorts between VDD and GND. Only connect the E1 or E20 after confirming that there are no mismatches of alignment on the user system port connector. Incorrect connection will result in the host machine, the emulator, and the user system emitting smoke or catching fire.

2.6. Internal Circuits of the Emulator

2.6.1. Internal Circuits of the E1 Emulator (RL78 Family)

Figure 2-12 show the internal circuits of the E1 emulator differing with RL78 Family.

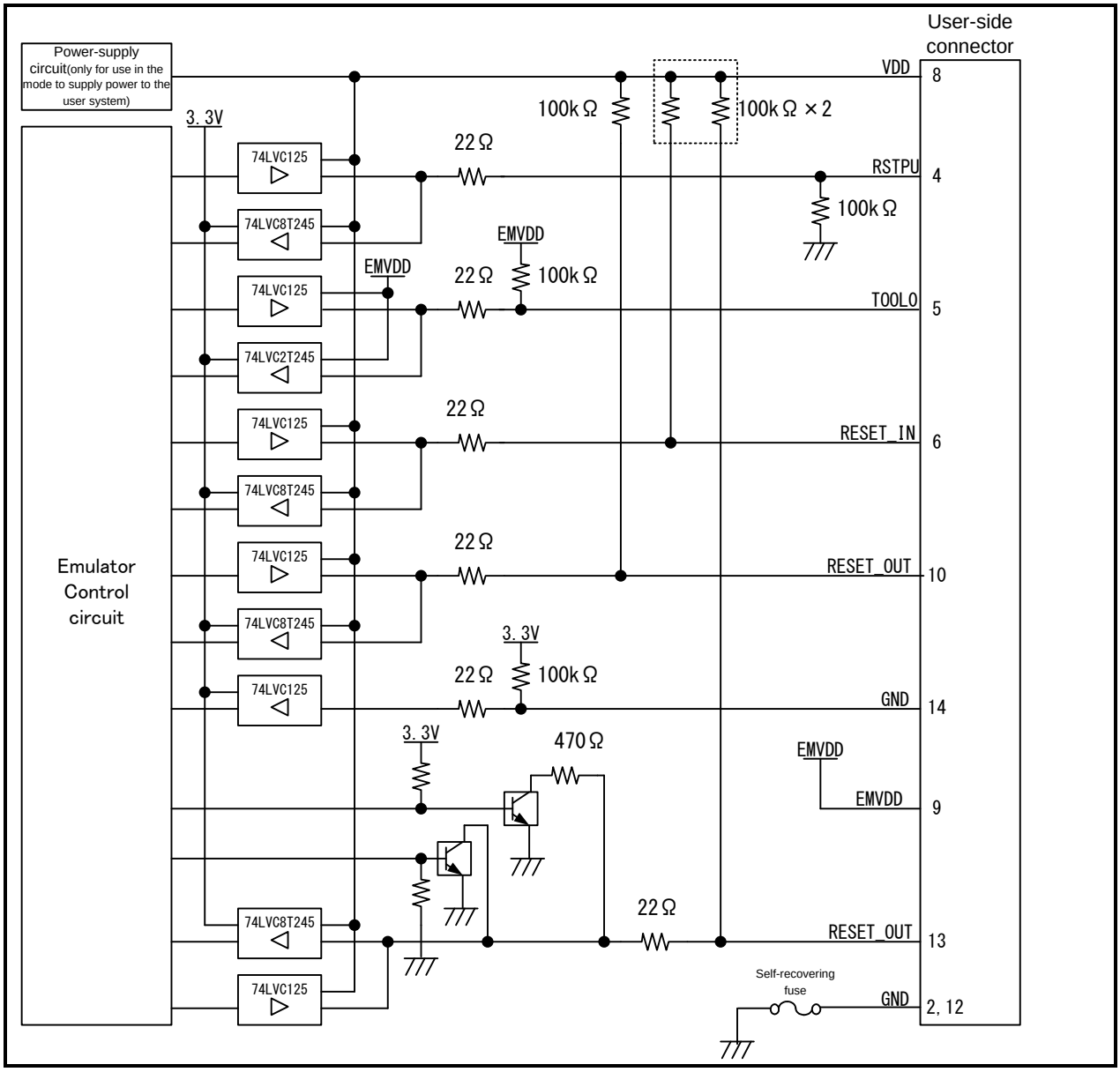


Figure 2-12 Internal Circuit of the E1 Emulator (RL78 Family)

2.6.2. Internal Circuits of the E20 Emulator (RL78 Family)

Figure 2-13 show the internal circuits of the E20 emulator .

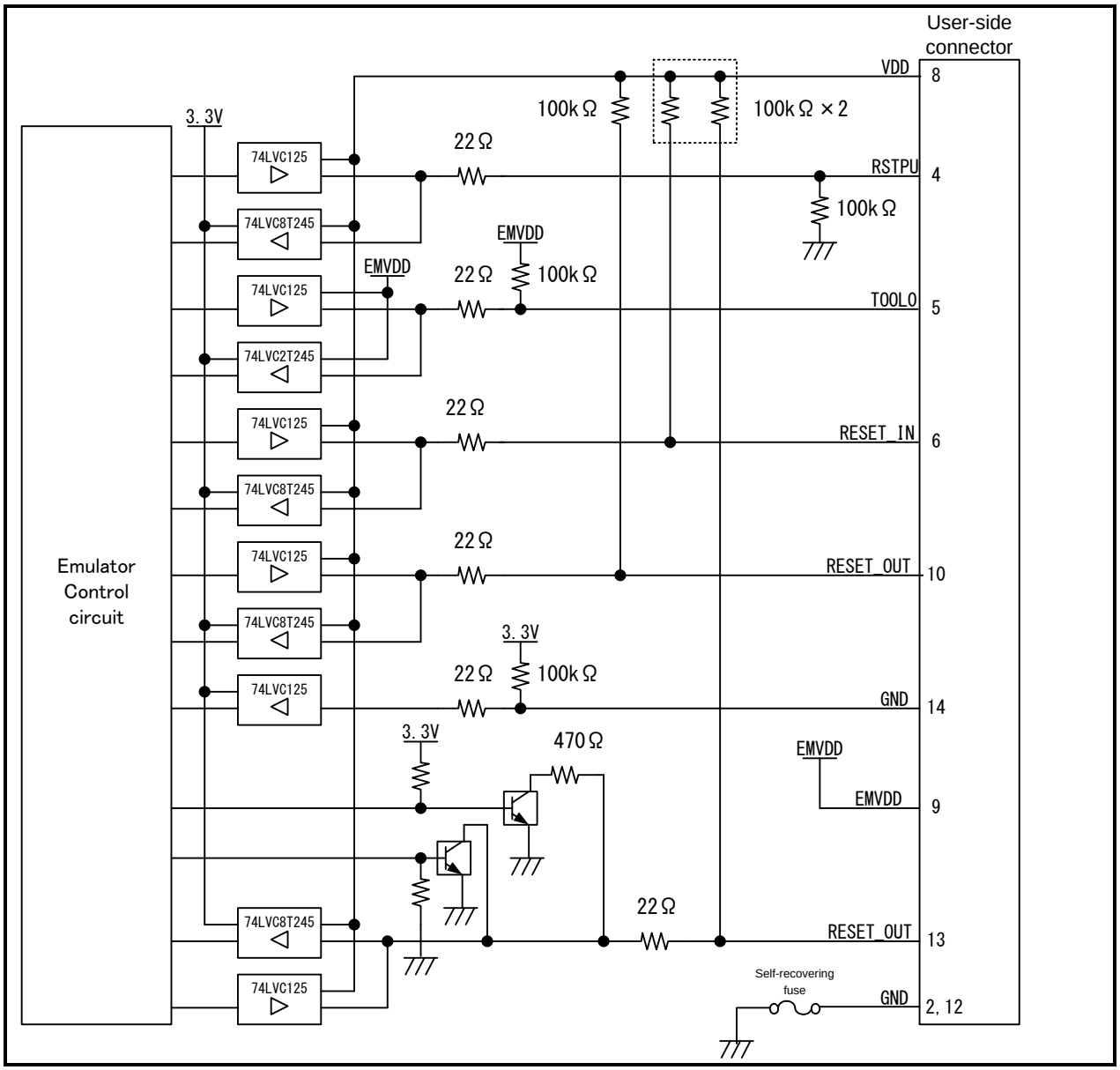


Figure 2-13 Internal Circuits of the E20 Emulator (RL78 Family)

2.7. Notes on Designing the User System

2.7.1. Isolators for the E1 and E20 Emulators

For a debugging environment where there is a GND gap between the user system and host PC, use the isolator for the E1 emulator (R0E000010ACB20) that is separately available from Renesas.

2.7.2. Small Connector Conversion Adapter for the E1 Emulator

The small connector conversion adapter for the E1 emulator (R0E000010CKZ11) is separately available from Renesas for a user system board which is too small to mount the 14-pin connector that is the standard connector for the E1 emulator. By using the adapter, you can reduce the area taken up by the connector mounted on your system.
When you use the Small Connector Conversion Adapter for the E1 Emulator (R0E000010CKZ11) that is separately available from Renesas, be aware that the connector pin assignments differ from those of the E1 emulator's standard interface connector. The 14-pin connector pin assignments when the Small Connector Conversion Adapter for the E1 Emulator is used are shown in Table 2-4.

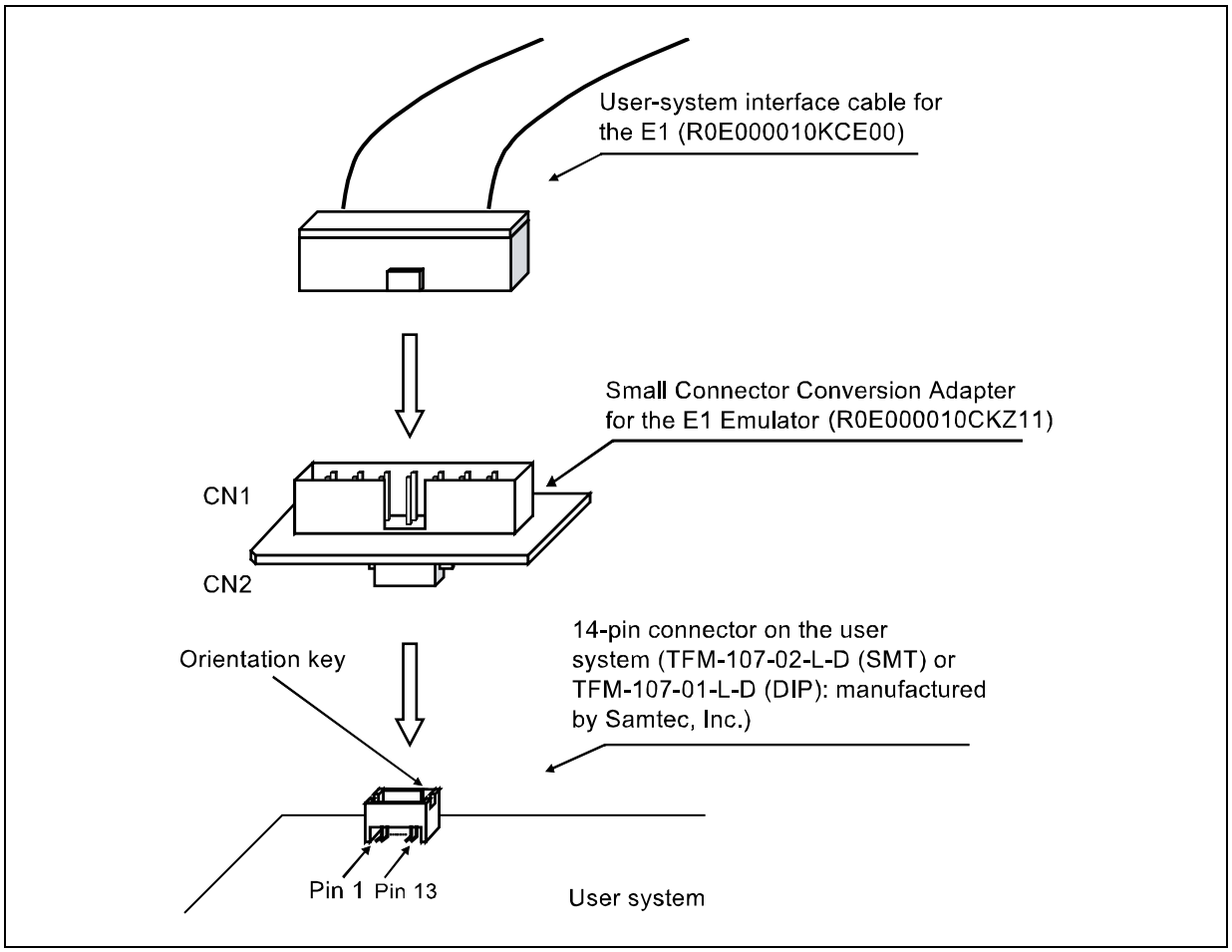

User-system interface cable for the E1 (R0E000010KCE00)
Small Connector Conversion Adapter for the E1 Emulator (R0E000010CKZ11)
CN1
CN2
Orientation key
14-pin connector on the user system (TFM-107-02-L-D (SMT) or TFM-107-01-L-D (DIP): manufactured by Samtec, Inc.)
Pin 1
Pin 13
User system

Figure 2-14 Usage of the Small Connector Conversion Adapter for the E1 Emulator

Table 2-4 Connector Pin Assignments when Small Connector Conversion Adapter for the E1 Emulator is Used

Pin No.	Other than the 20-pin and 24-pin versions of RL78/G12		20-pin and 24-pin versions of RL78/G12		Note
	Signal *1 *2	Direction *3	Signal *1 *2	Direction *3	
1	GND *4	—	GND *4	—	
2	R.F.U *6	—	R.F.U *6	—	
3	VDD	—	VDD	—	
4	R.F.U *6	—	R.F.U *6	—	
5	RESET_OUT *5	Input	RESET_OUT *5	Input	This pin is used to output reset signal to the target device
6	GND *4	—	GND *4	—	
7	RESET_OUT *5	Input	RESET_OUT *5	Input	This pin is used to output reset signal to the target device
8	R.F.U *6	—	R.F.U *6	—	
9	R.F.U *6	—	R.F.U *6	—	
10	TOOL0	I/O	TOOL0	I/O	This pin is used to transmit command/data to the target device
11	R.F.U *6	—	RSTPU	Input	This pin is used to pull up the reset line. (Only when selecting the 20-pin and 24-pin version of the RL78/G12.)
12	RESET_IN	Output	RESET_IN	Output	This pin is used to input reset signal from the user system
13	EMVDD *7	—	EMVDD *7	—	
14	GND *4	—	GND *4	—	

*1 For details on the programming software, refer to
http://www.renesas.com/products/tools/flash_prom_programming/

*2 These are the names of the MCU pins at the time the E1 or E20 is connected (i.e. during debugging).

*3 Input to or output from the user system.

*4 Securely connect pins 1, 6, and 14 of the connector to GND of the user system. These pins are used for electrical grounding as well as for monitoring of connection with the user system by the E1/E20.

*5 Securely connect both pin 5 and pin 7.

*6 This pin is reserved. For the connection of the reserved pins, see each circuit related to the pins.

*7 Connect the drive power of the TOOL0 pin.
Please connect VDD when the MCU doesn't have power supplies other than VDD such as EVDD.

3. Notes on Usage

3.1. Turning the Power On/Off

Turn the power of the E1 or E20 emulator and the user system following the procedure below.

3.1.1. When a Separate Power Supply is Used for the User System

<When using the emulator>

(1) Check the power is off.
Check that the user system is turned off. When using the E20 emulator, check its power switch is off.

(2) Connect the user system.
Connect the emulator and the user system with a user-system interface cable.

(3) Connect the host machine and turn on the emulator.
Connect the emulator and the host machine with a USB interface cable. The E1 emulator is turned on by connecting the USB interface cable. When using the E20 emulator, turn on its power switch.

(4) Turn on the user system.
Turn on the user system.

(5) Launch the emulator debugger.
Launch the emulator debugger.

<When finished using the emulator>

(1) Close the emulator debugger.
Close the emulator debugger.

(2) Turn off the user system.
Turn off the user system.

(3) Turn off the emulator and disconnect the emulator.
When using the E20 emulator, turn off its power switch. Disconnect the USB interface cable from the E1 or E20 emulator. The E1 emulator is turned off by disconnecting from the USB interface cable.

(4) Disconnecting the user system.
Disconnect the user-system interface cable from the user system.

CAUTION

Notes on the User System Power Supply:

While the power of the user system is on, do not turn off the host machine, unplug the USB interface cable, or turn off the power switch of the E20 emulator.
The user system may be damaged due to leakages current.

3.1.2. When Power is Supplied to the User System from the Emulator (E1 Only)

<When using the emulator>

(1) Connect the user system.
Connect the emulator and the user system with a user-system interface cable.

(2) Connect the host machine and turn on the emulator.
Connect the emulator and the host machine with a USB interface cable, then turn on the emulator.

(3) Launch the emulator debugger.
Launch the emulator debugger and select the setting of power supply to the user system.

<When finished using the emulator>

(1) Close the emulator debugger.
Close the emulator debugger.

(2) Turn off the emulator and disconnect the emulator.
Disconnect the USB interface cable from the emulator, then turn off the emulator.

(3) Disconnecting the user system.
Disconnect the user-system interface cable from the user system.

3.2. Power Supply Function of the E1 Emulator

When using the power supply function of the E1 emulator, check the voltage supplied to the user system. Particularly, when the 5.0V supply option is selected, the voltage may drop 0.5V or more since it depends on the USB VBUS power supply voltage.

When debugging a system with two power supplies (VDD, EVDD, etc.) to the MCU, power cannot be supplied from the E1 emulator.

3.3. MCU Resources to be Occupied

Figure 3-1 shows the areas which are occupied by the E1 or E20 emulator for debugging.
These areas (shaded sections) are used for debugging. These areas should not be changed to save the user program or data. If a change is made, control by the E1 or E20 emulator is no longer possible.

However, when "No" is selected in the [Permit flash programming] property of the debugger, the internal ROM space shown in Figure 3-1 is not used (only the internal RAM space is used).
When selecting not to permit flash memory rewriting with the debugger's property, also refer to section 3.3.3 Setting of On-chip debugging option byte, and section 3.6.2 Operation for Voltages and Flash Operation Modes Not Permitting Flash Memory Rewriting.

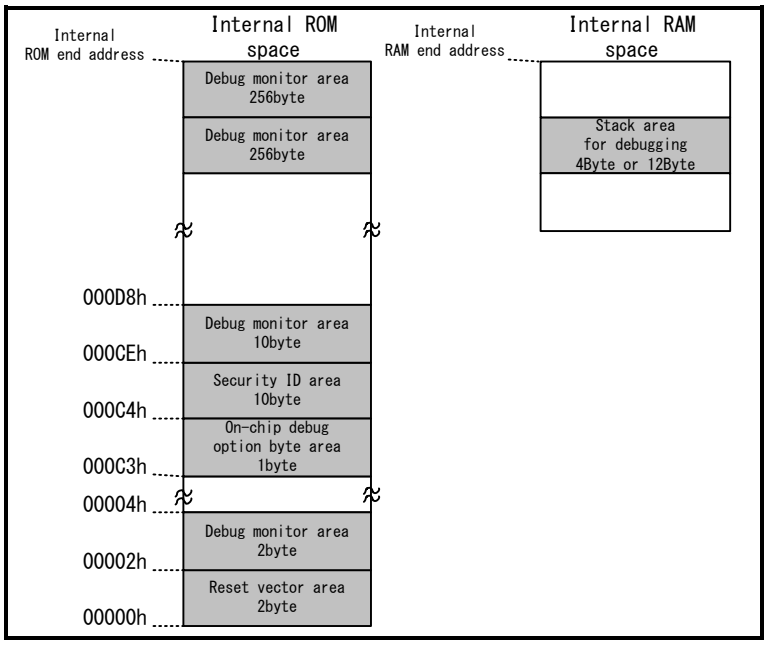


Figure 3-1 MCU Resources to be Occupied

*1	The reset vector area is used by the program for the E1 or E20 emulator when performing debugging with the E1 or E20 emulator. If the contents of the reset vector area are changed, control by the E1 or E20 emulator is no longer possible.

3.3.1. Securing of debug monitor area

This is the area to which the debug monitor program is to be allocated. The monitor program performs initialization processing for debug communication interface and RUN or break processing for the CPU.

This user programs or data must not be placed in an area of 23 bytes near the on-chip debug option byte, and an area of 512 bytes [Note1] before the internal ROM end address.

In addition, reset vector is rewritten to address allocated to a monitor program.

[How to secure areas]

It is not necessarily required to secure this area if the user program does not use this area.

However To avoid problems that may occur during the debugger startup, it is recommended to secure this area in advance, using the compiler.

Note: 1 Becomes 256 bytes when the pseudo RRM function and pseudo DMM function are not used.
Example (device with 256 Kbytes of on-chip ROM)

Pseudo RRM/DMM function is not used:
Monitor program is located at addresses 0x3FF00 to 0x3FFFF (256 bytes).
Pseudo RRM/DMM function is used:
Monitor program is located at addresses 0x3FE00 to 0x3FFFF (512 bytes).

3.3.2. Securing of stack area for debugging

This area requires 4 bytes as the stack area for debugging Note. Since this area is allocated immediately before the stack area, the address of this area varies depending on the stack increase and decrease. That is, 4 extra bytes are consumed for the stack area used.

Make sure the stack area for debugging does not exceed the range of the internal RAM space. Note1

Figure 3-2 shows an example in which the stack area has increased with the start address of the internal RAM space being 0xFCF00.

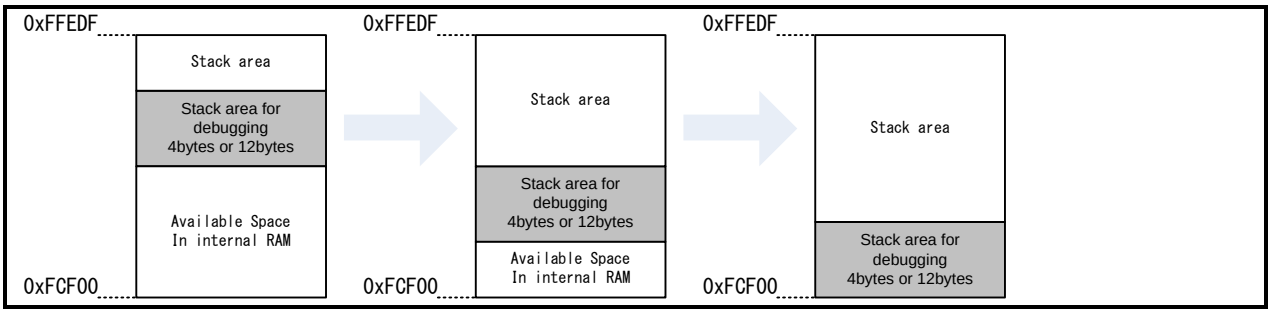


Figure 3-2 Variation of Address of Stack Area for Debugging

Note: 1 When the self programming is executed, it will be 12 bytes.
Refer to the self programming manual for how to secure the stack area for self programming.

3.3.3. Setting of On-chip debugging option byte

This is the area for the security setting to prevent the flash memory from being read by an unauthorized person.
For settable values, refer to the user's manual for each MCU.

[How to secure areas] *1
A setting method of On-chip debug option byte is following.

(a) Embed the On-chip debug option byte at addresses 0xC3 in the user program
Embed the On-chip debug option byte at addresses 0xC3 in the user program

(b) Set the On-chip debug option byte by build tool link options.
For details on the setting method, refer to the user's manual for the build tool.

*1 If the value of the on-chip debug option byte set in the device disables on-chip debugging (OCDENSET = 0), the debugger cannot be started when "No" is selected in the [Permit flash programming] property of the debugger. If a setting to enable flash programming is made, though the debugger can be started, the flash memory will be in an erased state when the debugger is started.

3.4. Setting of Security ID

This setting is required to prevent the memory from being read by an unauthorized person. Embed a security ID at addresses 0xC4 to 0xCD in the internal flash memory. The debugger starts only when the security ID that is set during debugger startup and the security ID set at addresses 0xC4 to 0xCD match. If the ID codes do not match, the debugger manipulates the target device in accordance with the value set to the on-chip debug option byte area (refer to the hardware manual for each MCU).

If the user has forgotten the security ID to enable debugging, erase the flash memory and set the security ID again.

A setting method of the security ID is following. When both (a) and (b) methods are done at a time, method (b) has a priority.

(a) Embed the security ID at addresses 0xC4 to 0xCD in the user program.
For example if the security ID is embedded as follows, the security ID set by the debugger is "0123456789ABCDEF1234" (not case-sensitive). Note1,Note2

(b) Setting of the security ID by build tool common options.
For details on the setting method, refer to the user's manual for the build tool.

Table 3-1 **Security ID**

Address	Value
0x000C4	0x01
0x000C5	0x23
0x000C6	0x45
0x000C7	0x67
0x000C8	0x89
0x000C9	0xAB
0x000CA	0xCD
0x000CB	0xEF
0x000CC	0x12
0x000CD	0x34

Note: 1 When connecting a debugger to a device for which the security ID has been set, the security ID needs to be entered in the debugger. For details on the authentication method, refer to the user's manual for the debugger in use.
2 "0xFFFFFFFFFFFFFFFFFFFF" which is a setting of only "0xFF" cannot be set.

3.5. Reset

3.5.1. Operation after a reset

After an external pin reset or internal reset, the monitor program performs debug initialization processing. Consequently, the time from reset occurrence until user program execution differs from that in the actual device operation. If “No” is selected in Permit flash programming in property of the debug tool, the time until the user program is executed compared with the time when “Yes” is selected is delayed several 100 ms.

3.5.2. SP value after a Reset

While debugging with the E1 or E20 emulator, the SP value after a reset becomes as follows:

- When the internal RAM space of the device is 768 bytes or more: FC00h
- When the internal RAM space of the device is less than 768 bytes:
  Start address of internal RAM + 0x20
  [Example] When the start address of internal RAM is 0xFEF00: 0xEF20

3.6. Flash Memory

3.6.1. Flash Memory Programming by Self-Programming

(1) Areas which cannot be rewritten by self programming
If a space where the debug monitor program is allocated is rewritten by flash self programming, the debugger can no longer operate normally. This caution also applies to boot swapping for such an area.

(2) Break occurring during self programming
Though breaks other than a forced break can be generated while self programming is in progress, step execution cannot be performed from where the break occurred. If a forced break occurs during self programming, control by the E1 or E20 emulator may not be possible.

3.6.2. Operation for Voltages and Flash Operation Modes Not Permitting Flash Memory Rewriting

When a voltage with which rewriting or erasure of flash memory cannot be performed has been selected or flash programming has been disabled with the debugger's property, the following debugger operations that accompany flash memory rewriting will cause an error in the debugger and the operations will be invalidated.

- Writing to internal flash memory
- Setting or canceling of software breakpoint
- Starting execution at the set software breakpoint position
- Step execution at the set software breakpoint position
- Step-over execution, Return Out execution
- Come Here
- Setting, changing, or canceling of hardware breaks
- Masking/unmasking of internal reset
- Switching of peripheral breaks

The operating frequency range and operating voltage range are set with the flash operation mode. Correct operation may not be carried out when the operating frequency range or operating voltage range is exceeded.

3.7. GDIDIS

The global digital input disable register (GDIDIS) which is used to prevent through-current flowing from the input buffers when the EVDD power supply is turned off (EVDD = 0 V) cannot be used in the E1 or E20 emulator. This is because the TOOL0 pin of the EVDD power supply cannot accept input when GDIDIS = 1 (Input to input buffers prohibited.) and so communication with the E1 or E20 emulator is broken.

3.8. RESET/PORT Multiplexed pin

In the 20-pin and 24-pin versions of the RL78/G12, the RESET# pin has multiplexed pin functions. Therefore, if the following conditions are all satisfied, control by the E1 or E20 emulator is no longer possible.

- The reset/port multiplexed pin is used as a port (PORTSELB = 0) due to the option byte setting (C1h).
- The option byte setting (C1h) has been rewritten during a break.
- "Yes" is selected in the [Mask INTERNAL RESET signal] property of the debugger.

3.9. MCUs that are used in debugging

MCUs that are connected to the emulator and used in debugging are placed under stress by repeated programming of flash memory during emulation. Do not use MCUs that were used in debugging in mass-production for end users.

Also, as the E1/E20 emulator program is written to the MCU while debugging, do not save the contents of the MCU Flash memory which were used for debugging nor use them as the ROM data for products.

3.9.1. Standalone operation

After downloading a load module file to the device to for on-chip debugging, do not check the operation of this device without E1/E20.

A device after debugging contains the specific program for on-chip debugging, so it is different from actual operation.

3.10. Final Evaluation of the User Program

Before entering the mass-production phase, be sure to perform a final evaluation of the program which is written to a flash ROM the Renesas Flash Programmer or PG-FP5, etc. Be sure to perform the evaluation singly, without the E1 or E20 emulator connected.

3.11. Debug functions

3.11.1. Step execution

(1) Cautions on using step-in (step execution)
The value of some SFRs (special function registers) might remain unchanged while stepping into code. If the value of the SFRs does not change while stepping into code, operate the microcontroller by continuously executing the instructions instead of executing them in steps.
Stepping into code: Instructions in the user-created program are executed one by one.
Continuous execution: The user-created program is executed from the current PC value.

(2) Step-in (step execution) of Division operation (target: device with multiplier and divider/multiply-accumulator).
When the instruction which sets (1) the bit 0 (DIVST) of Multiplication/Division control register (MDUC) is stepped, the division operation is not finished. The step execution of the division operation of C source file is not relevant.

(3) Illegal memory access detection
When the function to detect illegal memory accesses is enabled (IAWCTL.7 = 1), an internal reset will not occur even when step execution is performed for an instruction that will generate an illegal memory access.

3.11.2. [Go to Here]

If [Go to Here] is selected, the software breakpoints and event breakpoints that have been set so far will be temporarily invalidated.

3.11.3. Standby Function

The break is interrupt function of CPU. The standby mode is released by the break for using the following debug function.

<1> Stop execution of the user program.
<2> Step execution of the standby instruction (Stops user program after execution instruction)
<3> Pseudo real-time RAM monitor function (Break When Readout)
<4> Pseudo Dynamic Memory Modification (Break When Write)
<5> Set breakpoint while executing the user program.

3.11.4. Pseudo real-time RAM monitor function or the pseudo Dynamic Memory Modification

Note the following points when using the pseudo real-time RAM monitor function or the pseudo Dynamic Memory Modification (DMM).

・Standby mode (HALT or STOP) may be cancelled during monitoring.
・The pseudo real-time RAM monitor function or the pseudo Dynamic Memory Modification（DMM）does not operate while the CPU operating clock is stopped.
・When the number of monitoring point are numerous, the response of the debugger becomes slow. Influence to the debugger response becomes small by using a watch panel instead of a memory panel.
・When operating on the sub clock, neither the pseudo RRM function nor the pseudo DMM function will operate.
・Even when the RAM guard function is enabled, memory contents can be rewritten by the pseudo DMM function.

3.11.5. Emulation of flash memory CRC accumulator function

(1) High-speed CRC (code flash : all area)
The operation result of CRC is different from actual result. Because monitor program is arranged and reset vector is rewritten by on-chip debugging. Please check the operation of high-speed CRC by using IECUBE or using device without E1/E20.

(2) General-purpose CRC(code flash : specification area)
The operation result of CRC at following areas is different from actual result. Because monitor program is arranged and reset vector is rewritten by on-chip debugging.

- reset vector area
- debugging monitor area
- on-chip debugging option byte area
- software break setting area

3.11.6. Break Function

When "System" is selected in the [Monitor clock] property of the debugger, if a break occurs while operating on the sub clock, the E1 or E20 emulator switches the system clock to the main clock. Note the following in such a case.

- If the external clock (EXCLK) is set as the main clock, when a break occurs with the external clock stopped, an error will occur because the clock cannot be switched.
- Even if an SFR related to the clock is changed during a break, this change will be set in the device just before the user program is executed. Accordingly, the status flag does not change the moment the SFR is changed.
- When an SFR is rewritten to change the system clock to the sub clock during a break, though the E1 or E20 emulator switches to the sub clock just before the user program is executed, this sometimes results in an error after user program execution due to the oscillation stabilization wait time. In this case, set "User" for [Monitor clock] before debugging.

3.11.7. Events can be set and deleted during user program execution

Events can be set and deleted during user program execution. However, if a pin reset occurs after an event has been set or deleted, the contents of the event that was set or deleted during user program execution will be cleared.

3.11.8. Trace Function

When selecting not to permit flash memory rewriting with the debugger's property, the debug monitor area will not be located within 256 bytes below the end address of internal ROM. However, trace data cannot be acquired for this area.

E1/E20 Emulator
Additional Document for User's Manual
(Note on Connection for RL78)

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Renesas Electronics America Inc.
2880 Scott Boulevard Santa Clara, CA 95050-2554, U.S.A.
Tel: +1-408-588-6000, Fax: +1-408-588-6130

Renesas Electronics Canada Limited
1101 Nicholson Road, Newmarket, Ontario L3Y 9C3, Canada
Tel: +1-905-898-5441, Fax: +1-905-898-3220

Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K
Tel: +44-1628-651-700, Fax: +44-1628-651-804

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-65030, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
7th Floor, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100083, P.R.China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 301, Tower A, Central Towers, 555 LanGao Rd., Putuo District, Shanghai, China
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

Renesas Electronics Hong Kong Limited
Unit 1601-1613, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2886-9318, Fax: +852 2886-9022/9044

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics Korea Co., Ltd.
12F., 234 Teheran-ro, Gangnam-Gu, Seoul, 135-080, Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5141

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Colophon 2.0

E1/E20 Emulator
Additional Document for User's Manual
(Note on Connection for RL78)

Renesas Electronics Corporation

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